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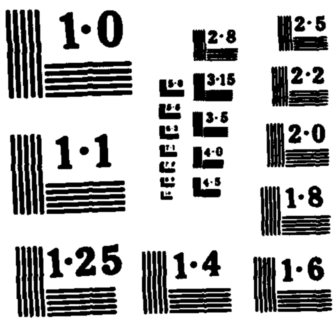
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A MOBILIZATION PREPAREDNESS PRIMER FOR WATER MANAGEMENT AT AMMUNITION PLANTS

BY

LTC HAL W. STEPHENSON, USAR

2 December 1985

The findings in this report are not to be construed as an official Department of the Army position.

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Preface

This is a brief outline using technological assessment and forecasting to aid the manager and planner concerned with water.

Equal Opportunity Statement

This report is written in nonsexist script. You are invited to imagine yourself as the planner, manager, and other persons mentioned.

Acknowledgement

The encouragement and advice of Mr. Otto F. Haase, Jr. was of great value during the preparation of this report.

Disclaimer

The views in this report are not to be construed as an official position of Department of the Army, DARCOM, or USAMCCOM. The ideas and recommendations are solely those of the author.

Why?

The real worth of water is discovered when it is needed but absent. The power of water must be recognized when it is present in excessive amounts as in floods and storms. In the normal range of water availability, there may be competition for water from local populations, industries and agriculture. The quality and content of water also changes and requires monitoring. Everyone must deal with or be affected by the quantity and quality of water and be concerned with the possibility of sabotage or natural calamity. In addition, the mobilization planner has to include contamination by the nuclear, biological, and chemical agents of warfare.

This guide is for the person who is responsible for planning for water management to achieve mobilization production levels of ammunition. This guidance can be used with appropriate modifications in water management for mobilization of industrial facilities. You don't have to be a hydrogeologist or sanitary engineer to read this guide. Many specialists must be properly used by a manager to prevent us from meeting a Waterloo through mismanagement of water. A parody on an old poem makes the point:

For want of water, production was insufficient
For want of production, a battle was lost
Because of battles lost, a war was lost
Because a war was lost, freedom was lost

Your orientation begins with the water cycle of the blue planet and then narrows the focus to existing and potential production sites. At production sites, we will find:

Who is in competition for water? Prediction and projection in water use forecasts is discussed.

What kinds of water are needed? Categories of water use are given.

How can a manager improve effectiveness and efficiency by giving attention to water management? Some examples of creative quick fixes are given.

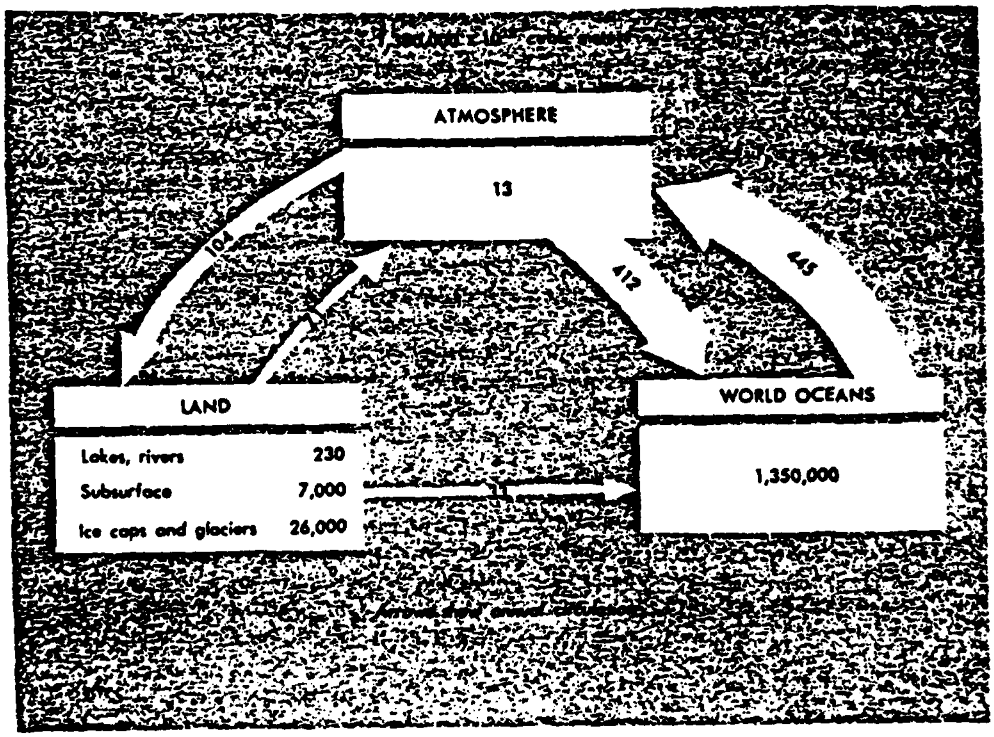
Where can data be found for water management planning? Some government and private organizations are listed.

When should a manager give extra attention to water management? A checklist of telltale signs is given.

The Water Cycle

Looking at the earth from an orbiting satellite confirms that ours is the water planet. Water is seen as a vapor in vast cloud formations, as a liquid in the oceans, seas, lakes, and rivers, and as a solid in the ice capped poles. The huge annual rates of circulation are diagrammed in Fig. 1. The pervasiveness of water does not, of course, mean that it will be in the right place at the right time—that's why management is needed if we are to achieve our production goals. To improve water management, there are certain things to look for and to do. Water cannot be taken for granted by planners just because the natural cycle provides an overall supply that is fairly steady at the rates given in Fig. 1. Variability occurs in when and where the water is located and the purpose of management is to find ways to take advantage of variability and avoid its disadvantages.

Fig. 1
Annual Circulation of the Hydrosphere
Source: Global 2000 Report, Vol. II, p. 138
Statistics are in quadrillions of cubic meters.



Who?

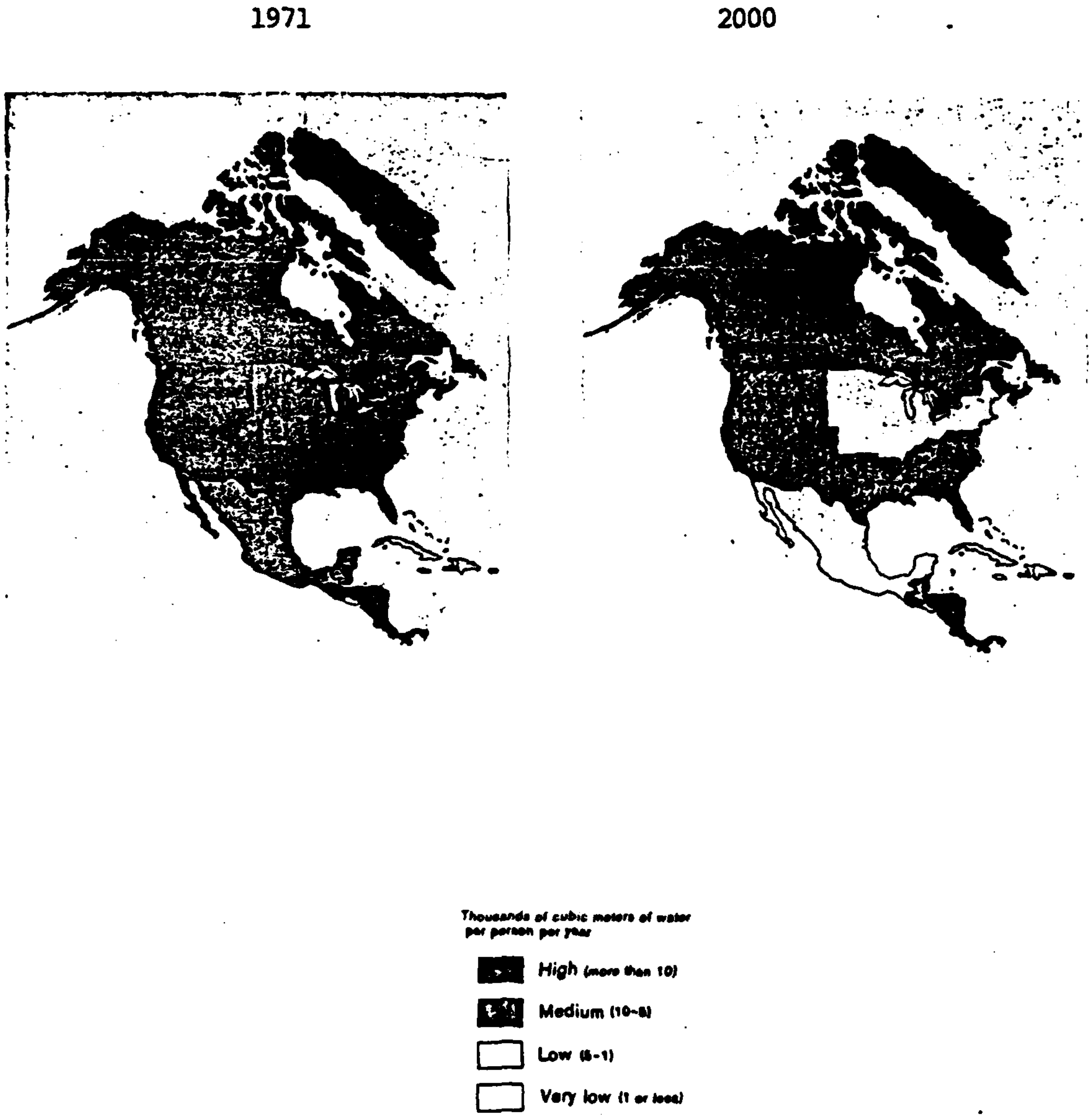
In addition to variability in the amount of water, the planner is concerned with water as a production process ingredient because projected increases in population, industrial use, and agricultural use can result in competition for water. An overall measure of this use can be seen in the water per person per year in 1971 compared with the projection for the year 2000 in Fig. 2. The continental United States water availability declines from high to medium in the northwest, southwest, and southeast and from medium to low in the northeast. These are projections based on many variables and are not predictions. A forecast for the year 2000 should be used as part of a manager's framework for understanding the relationships among resources that must be managed. In facility planning, remember that the reduction in the average amount of water per person is expected to occur because:

Natural net population growth (births minus deaths)
Industrial expansion
Net migration of people (immigration minus emmigration)
Agricultural use—especially irrigation

Irrigated land receives about 36 inches of artificial rain or ditch-fed water per year. Each acre of irrigated land gets about three acre-feet of water which is nearly one million gallons of water (977,000 gallons to be precise.) A medium sized ammunition plant uses twice this much water in normal peacetime production per day.

These uses of water are the answers to who will be competing for the available water in a watershed. When examining an existing or proposed production site, look upstream through the watershed and find out what activities will be using and releasing the water supply for your uses. In planning, take advantage of the variability in water supply by evading competitive points in a watershed when possible. An overall decline in per capita water is an average but the variability in water supply in the many segments of a region must be analyzed to find if evasive action is possible.

Fig. 2
Water Availability per Person
in North America in 1971 and 2000
Source: Global 2000 Report, Vol. I, p. 24-25



What?

What kinds of water are needed? First, you need primary and emergency sources of water. Rivers, lakes, and wells are common sources but realize that many types of soil and rock are permeable to water and form an aquafer which has unseen large volumes of water passing through them. Other sources of water include cisterns and desalination plants. A manager should ask a planner if the replenishment rates for the sources exceed the amount to be drawn from them when the facility is at its maximum production level. The kinds of water needed are:

Potable (drinkable) water
Filtered water
Raw water

Internal to the production process, one more kind of water is made by treatment prior to boiling for steam production.

Potable water requires the most extensive treatment. Fortunately, relatively little of the total volume required is potable water. When planning new or expanded facilities, be careful to look for an economic analysis of including a separate potable water system.

Filtered water is usually the largest portion of the total volume required for the production system and, incidentally, for the fire water system too.

Raw water is rarely of much use because it can clog pumps, valves, pipes, etc.

After you have looked at sources and uses of water, the systems for releasing the effluent need to be examined. Ammunition plants have pink water and red water effluents that must be treated. Pink water is the result of loading processes. Red water is a byproduct of manufacturing processes. Water is used in manufacture and loading because it carries away unsafe dust. The engineer is designing between the need for safety on the production line and society's need for water in the plant's effluent that is clean enough for subsequent use. Recycling of pink water can be done to reduce the volume of water needed. The disadvantage of recycling water is that the higher the concentration of explosive material contaminating the water, there is greater danger if the wrong kind of water leaks into another system. Hazardous leaks are to the boiler or the fire water system. Heat exchangers are particularly critical places where this transfer can occur. Eventually, whether water is recycled or not, it must be cleaned up. The standards of the Environmental Protection Agency are becoming more stringent. The design of a facility is being wedged in a necessary but pressing vice between safety standards and effluent standards. Effluent can be evaluated by checking the National Pollution Discharge Elimination System permits.

Other water systems include the sewerage system which is like any city has and the deluge control system or storm sewer. Other water problems may include requirements to provide water for nonmilitary customers. The civilian offpost population can be entitled to water supply when there is no civil source and the aquafer has been contaminated by seepage from the plant.

Water is unlike other materials in that it can be economically transported only limited distances. This is important in locating sites and may justify local civil use of treated water. Most plants are located near established towns that have their own water supply system.

How?

Effectiveness and efficiency through water management is achieved through long-range plans, contingency planning, and short-range plans including expedient actions during mobilization emergencies.

Preparedness through long-range planning includes an assessment to assure that water is available and the capacity for the various kinds of water is adequate. In particular, facility improvements that have a long leadtime should be given priority for accomplishment during normal times. Contingency planning includes an appraisal of the capacity if uncommitted facilities and areas were placed in use to meet higher than planned production requirements or needs caused by problems at other plants. Also included in contingency planning is preliminary site selection for new plants. Reserving excess federal land at this time is considered counter to the administration policy which favors divestitute of excess federal lands. In competing for a new site, the manager should be aware of two factors:

State governments are reasserting their rights to land management and especially to water management. There is a political consideration at the state level as well as at the Congressional level in site selection.

To gain permission to use a site, it may be necessary to justify its use when compared to alternative uses. One way to make this comparison is by benefit/cost analysis. The value of the use of one acre-foot of water per year to a state economy derived from various uses of the water is given in very approximate 1985 dollars as follows:

Value Added per Acre-Foot	Jobs Added	Use
$8000	750	Industrial
700	50	Recreation
100	10	Agriculture

Long range planning also includes liaison with the River Basin Commission which can be established when approved by half of the states in a river basin and approved by the Water Resources Council as provided in the Water Resources Planning Act of 1965. The Water Resources Council consists of the Secretaries of the Army, Interior, HEW, and Agriculture and the Chairman of the Federal Power Commission.

Medium range planning includes consideration to improving the intake, processing, and treatment capacities. These improvements receive most of the facility engineering planning effort. To improve the accuracy of water requirements, ask for a water product ratio or curve for each type of ammunition at various production quantities.

Contingency planning for mobilization receives considerable attention along with natural disaster, the effects of warfare, and security to prevent sabotage and terrorist action from succeeding.

Short range planning is the function of the operational staffs and receives much attention.

Some Creative Quick Fixes

Long range: To provide for water supply, the manager can take a very broad view of the situation and seek to lessen competition for the water supply. For example, if irrigation is encroaching on the aquafer's replenishment rate, consider working for more efficient use of water in the river basin. If the irrigation uses unlined ditches, 20% of the water can be lost by seepage so a civil works project to line the ditches could accomplish immediate and long term usefulness to our society while also enabling us to be prepared for mobilization.

Medium range: Projects which have lead times of several years and are not easily accomplished during mobilization fit here. Improvements for efficiency and safety such as recycling, dual systems, and covering ponds to prevent contamination by insects and birds belong here.

Contingency: Safety systems such as water quality monitoring in heat exchangers, treatment before boiling, and intake and effluent sampling belong here. Also, equipment, development of versatile and flexible procedures and testing to improve the speed with which the emergency water supply can be used belongs here.

Short range: In an emergency, creative thinking can result in expedients to overcome adverse factors such as a water shortage. If there isn't enough water but there is plenty of electric power, consider refrigerating the intake water so it can be used as cooling water. This is an uneconomical expedient but could be done in an emergency. At a distant generating site, 40 gallons of water are evaporated per kilowatt hour. This is, however, the type of thinking that can be brainstormed by a staff to overcome an otherwise difficult situation. Another example is when a watermain is leaking, then a plastic sheathing tube can be pulled through to maintain temporarily maintain water flow. Cities in Oklahoma experimenting with this have found that plastic tubing can substantially reduce losses due to leaking for weeks or months.

Where?

There are many federal agencies, state organizations, and private organizations that have water management functions.

Intake water supply information can be obtained from the U. S. Geological Survey which prefers problem-specific projects. Data on flood control and navigation is a function of the U. S. Army Corps of Engineers. Watershed development may be overseen by a River Basin Commission. The status of water can be obtained from the Environmental Protection Administration's water quality compliance system.

Most states have agencies and at least one university that contains a water management center.

Up to date names and addresses of private organizations concerned with water management can be obtained through a local library.

Not since the times of the Roman Empire has so great a portion of the human effort been put into water systems.

Do look for foreign technologies for better water conservation techniques. The state of the art calls for periodic reviews of new technology. Forecasters also tell us that it is better to make projections periodically and not to try to look too far into the future. An annual formal review of water management with continuous informal review will work well.

When?

Some things a manager can look for to gain an awareness of the water management status of the mobilization production program are:

Intake Availability--Does the capacity in the production preparedness report indicate the requirement at maximum mobilization production level? After getting that requirement in terms of the several kinds of water needed, check with the U. S. Geological Survey to assure that the replenishment rate of the source can provide the water with the quality needed. If there is not enough water, make sure it appears in deficiency section of the next report or issue an amended previous report.

Listen for telltale comments such as with present production, the watertable has dropped several feet and we are getting a reduced flow from our wells.

Water Use--Check the water quality monitoring system for drinking and process water. Check the sensors in the system, particularly for heat exchangers and boilers.

Emergency Use--Test the fire water system with primary and emergency water sources. How long does it take to connect to the emergency water source?

Storm Sewers--Inspect for signs of inadequate drainage. What would happen if there were a flood? Would the sewers back up?

Treatment Facilities--Ask to see the National Pollution Discharge Elimination System permits.

If new facilities or changes have triggered environmental impact statements or environmental assessment reports, read these to gain information on water status.

Plans--Ask for a summary of proposals to make improvements in the water systems and give attention to expediting the ones that are most worthwhile. Have proposals added to plans if the review outlined above discloses any telltale signs that indicate that the water systems won't work when needed in a drought or flood or for mobilization production.

Reports--Occasionally check the data in one report against other reports for consistency and completeness and ask for definitions of the terms used. For example, look up your installation in the Inventory of Military Real Property and look in codes 830 for water and sewage and codes 840 for water data.

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Water management for ammunition manufacture begins with projections of needs and competition for water at production sites. Categories of water and water use are analyzed by source, use, recycling, and discharge. Examples of creative quick fixes to meet water needs are given. A checklist of telltale signs for managers is given to enable them to increase attention to water management when necessary for reliable ammunition plant operation.

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